SB249
U5
v.1

The D. H. Hill Library

North Carolina State College

This book was presented by
Florida Dept. of Agriculture

SB249
U5
v. 1

NORTH CAROLINA STATE UNIVERSITY LIBRARIES
S01949932

66961

This BOOK may be kept out TWO WEEKS ONLY, and is subject to a fine [redacted] a day thereafter. It is due on the day indicated below:

4 My '43 ME
18 My '43 WC
23 Ja '46 S
15 Fe '46 S
4 Oct '50 X

Growing Sea Island Cotton Under Florida Conditions

Report of Works Progress Administration

★

STATE OF FLORIDA
DEPARTMENT OF AGRICULTURE
NATHAN MAYO, *Commissioner*
TALLAHASSEE

FOREWORD

As sponsor of the State-wide Boll Weevil Poison Program on Sea Island cotton in 1938, the State Department of Agriculture wishes to thank all growers who cooperated.

Owing to a prolonged spring drought which covered the area from Suwannee County southward and prevented the germination of seed until near May 1, followed by the terrific downpours of midsummer, it is felt that Sea Island cotton growers were confronted by almost insurmountable odds in 1938. In other words, research has shown that in order to grow Sea Island cotton successfully under Florida conditions extra early planting, followed by an intensive campaign to poison all over-wintered weevils, must be practiced. Where Sea Island cotton seed do not germinate until well up into the month of April due to moisture scarcity or late-planting, successful yields are seldom secured.

At the time this report goes to press acreage control has been removed from bright or flue-cured tobacco and late reports indicate that Sea Island acreage in the "Old Florida Sea Island Belt" may be reduced. Sea Island acreage increase is indicated only in the extreme southern and western edges of the Florida Belt.

The results of research work by the WPA Entomologists are brought up to date in the following report and all cotton growers will find much useful information concerning the Sea Island cotton problem.

This bulletin should be read carefully and stored for future use as Sea Island acreage will be greatly expanded if and when the price of bright tobacco makes the culture of that crop unprofitable. I wish to call particular attention to the

66961

Library
N. C. State College

remarks on the cotton stainer as this pest must be fought in the southern edge of the Florida Sea Island Belt if profitable crops are to be harvested.

The Sea Island market is expanding rapidly and attempts to grow this choice cotton will be made on a large scale in the Mississippi Delta during 1939.

All data and recommendations in this bulletin apply equally well to the production of short staple or upland cotton.

NATHAN MAYO,
Commissioner of Agriculture.

Mr. Robert J. Dill,
Director Florida Works Progress Administration,
Jacksonville, Florida.

Sir:

I have the honor to transmit herewith my annual report concerning the part played by the Works Progress Administration in the State-wide Boll Weevil Poison Program. This report covers the activity of the Works Progress Administration for the year 1938 and brings up to date the results of all research work.

Respectfully,

GEO. D. SMITH,
Entomologist in Charge.

SOURCES OF ILLUSTRATIONS

Most of the illustrations used in this bulletin are from Florida State Department of Agriculture publications, either bulletin No. 82, New Series, (April, 1937), or "A Graphic Review of Florida Agriculture," No. 99, New Series. References to these publications will be by number.

Fig. 1, original photograph by Mr. Robie.

Fig. 2, from page 11, bulletin 82.

Fig. 3, from "The Problem of the Cotton Boll Weevil and Its Solution," by Henry T. Dumbel.

Fig. 4, from page 19, bulletin 82.

Fig. 5, from page 21, bulletin 82.

Fig. 6, same source as Fig. 3.

Fig. 7, from page 15, bulletin 82.

Fig. 8, from page 23, bulletin 82.

Fig. 9, from page 17, bulletin 99.

Fig. 10, from page 35, bulletin 82.

Fig. 11, from page 34, bulletin 82.

Fig. 12, from page 49, bulletin 82.

Fig. 13, from page 61, bulletin 82.

Fig. 14, from page 29, bulletin 82.

Fig. 15, from photograph taken near Melbourne, Fla., by P. W. Calhoun.

GROWING SEA ISLAND COTTON UNDER FLORIDA CONDITIONS

INTRODUCTION

Since the publication in April, 1937, of a report of the Works Progress Administration describing the experiments and demonstrations relative to the rehabilitation of Sea Island cotton in Florida much additional information has been secured by the Entomologist in charge. Planted acreage has increased from a few hundred acres in 1935 to approximately 25,000 acres in 1938. The Sea Island market has been reestablished with both domestic and foreign mills bidding for baleage of this once "lost industry."

Largely through the free poison and molasses furnished growers during the State-wide Poison Programs of 1937-38, plantings have been made over the entire area from about Melbourne-Hillsborough Counties on the south to as far west as Pensacola. Gins have been erected to take care of the staple in practically all centers of production with approximately 18 gins now in operation.

Good grades and staple have been produced in all areas planted to Sea Island. In the rolling hill section around Tallahassee the cotton produced has been of excellent staple and character. The same result has been secured in the DeFuniak Springs-Baker area.

Since prospects for profitable upland cotton culture in Florida are now almost nil due to the heavy surplus and the lost export trade, Florida cotton growers are giving more and more thought to the culture of Sea Island.

The principal drawback to profitable Sea Island production in Florida is the boll weevil. However, the "Afternoon Method of Weevil Poisoning" developed by the WPA Entomologists, combined with extremely early planting dates, practically insures a profitable crop where the acreage planted can be properly poisoned and harvested. As an additional cash crop for small farmers, Sea Island cotton makes an excellent running mate for other cash crops such as bright tobacco, hogs, etc.

WORK UPON WHICH THIS REPORT IS BASED

The problem of growing Sea Island cotton under boll weevil conditions has been recognized by entomologists as probably the most difficult of all cotton problems. When the weevil first invaded the Sea Island Belt, about 1914-16, growers had made no effort to study the problem and the industry went out of existence within about three or four years. Of course, a few straggling fields were planted up to about 1927. However, certain seed stocks were kept by the U. S. Bureau of Plant Industry by planting a small acreage each year near Charleston, S. C.

In 1935 the Works Progress Administration, noting a few bales of Sea Island Cotton had been grown in 1934 near Trenton, Fla., in an area where no cotton had been grown for several years, decided to make an effort to rehabilitate the "lost industry" in the weevil-infested areas. Plantings were made in Madison County in 1935 on a very small scale—approximately 100 acres. WPA Entomologists were successful in developing a method of poisoning the over-wintered weevils and in 1936 Madison County Sea Island acreage was increased to approximately 450 acres. The 1936 crop was profitable and growers all over the "Old Sea Island Belt," began making inquiries for seed. This condition led to the State-wide Weevil Poisoning Programs of 1937 and 1938 under the auspices of the WPA.

In addition to proving Sea Island cotton could be grown under boll weevil conditions in Florida, the WPA, through the work of its entomologists, reestablished the market—both foreign and domestic.

The Florida Experiment Station and the Federal Bureau of Plant Industry have co-operated in the rehabilitation work and have made many valuable suggestions; the Experiment Station in having county agents co-operate in the poisoning program, improving seed stocks; and, the Bureau of Plant Industry in "rogueing" fields, plant breeding and keeping pure seed strains. The State Department of Agriculture, through Commissioner Nathan Mayo, has also been of invaluable assistance—acting as sponsor for the State-wide poisoning Programs in 1937 and 1938.

The work upon which this report is based represents a summary of four years work by WPA Entomologists. The results of the 1935-36 experiments were published in the spring of 1937 and the present report brings the research work of all four years up to date.

Fig. 1. About the only type of farm conveyance that did not come to the Madison, Fla., free poison and syrup dispensing station was a wheelbarrow.

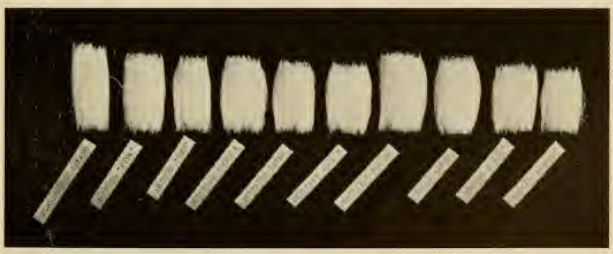


Fig. 2. Staples of the world's fine cottons showing comparative length of staples. Left to right: Florida Sea Island, Arizona "Pima," Arizona "SXP," Egyptian Sakha 4, Egyptian Sakel, Egyptian Giza 7, Egyptian Maarad, Sudan Sakel, Peeler $1\frac{1}{4}$", Peeler $1\frac{3}{16}$".

ECONOMIC CONSIDERATIONS

Prior to the spread of the boll weevil over the Cotton Belt, the production of Sea Island Cotton was confined to a comparatively small area in the Southeastern part of the Belt. In this area, quite a few of the counties grew Sea Island to the practical exclusion of upland varieties, while the adjoining county grew upland almost exclusively.

As an illustration, Madison County, Fla., produced an average of six or eight thousand bales of Sea Island cotton each year, and very little upland, whereas the adjoining county of Jefferson produced considerable upland cotton and practically no Sea Island.

No satisfactory explanation has been advanced for this peculiar condition. Sea Island cotton grows much better in some localities than in others, but the adaptability or non-adaptability of the plant itself by no means explains all the peculiarities of its distribution in pre-boll weevil days.

Several factors, however, contributed considerably to the stability of the distribution of Sea Island and upland cotton. Once Sea Island or upland cotton becomes predominant in a community, the other finds itself at a disadvantage. Different types of gins are required, and buyers pay the most attention to the staple that can be bought in greatest quantity. Labor trained to grow, pick and handle upland cotton is not always satisfactory for Sea Island and vice versa. If given a fair trial, Sea Island, no doubt, would be found to produce satisfactorily in many localities where it has never been grown. However, when such trials are made, it should be borne in mind that it is a new crop, and too much should not be invested in it until it proves its worth. Broadly speaking, it is most promising where there is an abundance of well drained soil, on which cotton tends to fruit well without producing excessive stalk, and where boll weevils are not abnormally numerous. In addition, an abundance of cheap labor must be available during the harvesting season.

THE BOLL WEEVIL PROBLEM

That the boll weevil is the most important single factor in the production of Sea Island cotton in the Southeastern Belt is apparent from the fact that the Sea Island industry was virtually wiped out in three years after the arrival of the pest.

There are several contributing factors to the extreme susceptibility of Sea Island cotton to boll weevil damage. The chief reason probably is that it is a comparatively slow maturing variety which gives the weevils sufficient time to breed in larger numbers before the bolls mature. The bolls also are thin-rined, which enables the female weevils to place the eggs farther into the tissues of the lint than is the case with upland bolls of equal age. Sea Island bolls are softer than upland bolls, and generally more attractive to the weevil. In the case of upland cotton, the bolls are not appreciably damaged by the weevil until a very large percentage of the squares have been punctured, whereas Sea Island bolls are often attacked by the weevil in preference to squares.

In addition to its greater susceptibility to boll weevil damage, weevils are ordinarily more numerous in a community growing Sea Island cotton than if upland cotton were grown. There is more than one reason for this, probably the most important one being that Sea Island cotton tends to produce a second growth of foliage, squares and blossoms in the fall after the crop is harvested to a much greater extent than does upland, giving the fall crop of weevils an abundant supply of nutritious food on which to fatten for winter. Moreover, a larger number of weevils usually emerge from the top bolls of Sea Island during late summer and early fall than from upland bolls. Generally, weevils may be expected to be about twice as numerous in the spring in communities growing Sea Island compared with areas where upland cotton is grown. Anyone contemplating the production of Sea Island cotton, therefore, should study the life history and habits of the boll weevil and diligently apply positive control measures, otherwise eventual failure will be a practical certainty.

DESCRIPTION AND LIFE HISTORY

The adult boll weevil averages about 3/16 inch long, resembling somewhat a tiny elephant. When it first emerges from a square or boll, it is reddish brown, but turns darker as it ages. Old adults, especially those that have passed the winter, are grayish in color.

Most female weevils lay from eight to twelve eggs a day, in as many squares, until a total of a hundred or more eggs are deposited. In three or four days the egg hatches into a tiny grub, which soon begins to feed on the succulent square tissues surrounding it. In about ten days, the square flares,

turns yellow, and falls from the plant. By this time the white curved grub will be about an eighth of an inch long, and somewhat flattened.

In about twelve or fourteen days after the egg is deposited, the grub begins to grow wing pads and a thin white "bill" which lies on the under side. It is now a pupa, or "kicker." If alive and healthy, each time it is touched it will wiggle vigorously. This stage lasts about a week before the pupa completes its transformation into a fully developed, soft reddish adult weevil, ready to escape from the hollowed out brown squares or boll. Thus the complete developmental period from egg to adult under ordinary summer field conditions, is about 21 days. Approximately another week elapses before the young females become sexually mature, and begin to deposit eggs. A complete weevil generation in Florida ordinarily requires about 28 days in the summer. Very favorable temperature and moisture conditions will shorten this period somewhat, while dry cool weather in the fall lengthens it.

FIG. 3. STAGES OF THE MEXICAN COTTON BOLL WEEVIL

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 1, Cotton boll weevil, top view of adult; fig. 2, ventral view of pupa; fig. 3, egg; fig. 4, side view of larva; fig. 5, adult with wings spread. Fig. 1, enlarged to five diameters; fig. 2, enlarged to about 4 diameters; fig. 3, enlarged to 12 diameters; fig. 4, enlarged to four diameters; fig. 5, enlarged to four diameters.

HIBERNATION

In the fall, after the cotton is killed by frost, the adults seek shelter in nearby trash, fence rows, woods, etc., to spend the winter. Ordinarily only a small percentage of these succeed in surviving until the following spring, but the percentage varies greatly according to conditions. If the cotton field from which they migrated continued to square and blossom until frost, most of the weevils will be strong and healthy, and will have a good store of fat to draw upon for their long fast, enhancing their chance of surviving the winter. If, however, the weevils migrated from a field which ceased to square and bloom long before the beginning of cool weather, they will have a scant store of reserve energy, and their chance of surviving the winter will be small. The boll weevil, like all insects, is cold-blooded, and therefore consumes energy slowly or rapidly, more or less according to whether the weather is warm or cold. If they are forced to go a month, or even two weeks, without food in the fall while the weather is yet warm, a large part of their reserve energy is used up, and their chance of surviving the winter will be small. In the fall of 1937 most of the cotton in northern Florida was completely defoliated by the cotton leaf worm during the last week of September. The weevil infestation was considerably lighter than usual the following spring.

The type of shelter the weevil finds will greatly influence its chance of surviving the winter. Dry grass, which affords but little protection from changes in temperature, carries but few weevils through the winter. Spanish moss, on the other hand, is excellent protection against violent temperature changes, and carries large numbers of weevils through the winter. Most cotton planters know only too well that cotton planted near damp, mossy woods is usually heavily infested by over-wintered weevils.

In the spring, as soon as the average mean temperature reaches 56° F, the adult weevils gradually leave their hibernating quarters and seek cotton fields. In heavily infested localities weevils will be in the earliest cotton before squares form. The emergence period usually lasts until well into June in Florida. Around very thin open woods, emergence is completed by June 5-10, but around mossy swamps it is not complete until around June 20.

The rate of emergence from hibernation is slower during dry than during damp weather. The optimum conditions for

emergence are showers every few days, with hot sunshine between.

Adult over-wintered females do not begin to deposit eggs immediately upon entering a cotton field as it is necessary for them to feed on squares about a week before eggs mature. After this period of feeding, however, the over-wintered female is as prolific, if not more so, than a female that has not lived through winter.

Fig. 4. Showing one type of hibernating quarters for the boll weevil commonly found in the Sea Island Cotton Belt.

In well drained pine woods surroundings such as are shown above, the poisoning operation need not be continued after June 10 or 12. Weevils emerge from such surroundings earlier in the spring than in damp mossy situations, and are generally not as numerous.

Very small amounts of poisoned-syrup mixture are required to mop an acre of cotton with a poor stand such as shown here. This would not be the case if the poison were applied with a power sprayer or dusting machine, which would put most of the poison on the ground instead of the cotton plants.

Fig. 5. Showing another type of hibernating quarters for boll weevil.

In damp, mossy situations such as is shown above, the poisoning operation should be continued until June 18 or 20, since the emergence of the weevils from such hibernating quarters continues until comparatively late in the spring.

Perfect control of the weevil was obtained in this field of Sea Island cotton with the WPA afternoon poisoning method, in spite of the fact that cotton was grown near this swamp the previous year.

DAMAGE

Although weevils destroy a large number of squares during the course of a season if not kept under control, the principal damage is to the bolls. On upland cotton, the bolls are attacked only after squares become scarce. Then small bolls are punctured in the same manner that squares are. A hole is eaten through the rind, an egg is deposited, and the hole is sealed. If the boll is small and the rind thin, the egg is placed in the lint, and that lock will be ruined by the feeding grub. Often many eggs are laid in one boll, and the entire boll is ruined. If the rind of the boll is too thick to enable the female to place the egg in the lint, however, as is frequently the case with upland bolls two weeks or more old, the immature weevil frequently perishes, and the boll is not seriously injured by the puncture. Sea Island bolls are attacked much more freely than upland bolls, and their thinner rind makes it possible for the female to place the egg in the lint until the boll is practically grown. Sea Island bolls are therefore much more susceptible to weevil damage than are upland bolls.

Fig. 6. Damage to inside of cotton bolls and squares by feeding of immature weevil stages.

Figs. 1, 2 and 4 enlarged two diameters; fig. 3, enlarged one diameter. From photographs.

Fig. 1

Fig. 2

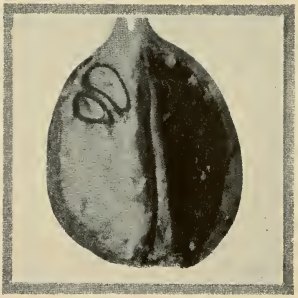


Fig. 3

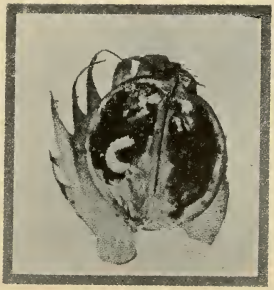


Fig. 4

BOLL WEEVIL CONTROL

ARTIFICIAL CONTROL

After the cotton is chopped, close watch should be kept for the appearance of tiny squares, and, as soon as they appear, poisoning for the weevil should be begun.

The "Afternoon Mopping Method of Control" has proven its worth over a period of years and under diverse conditions. Virtually all Sea Island Cotton planted in Madison County in 1935, '36, '37 and '38 was poisoned by this method, and weevil damage was inconsequential on March-planted cotton. This was also true on most of the remaining Florida Sea Island acreage in 1937 and 1938. However, supplementary poisoning had to be resorted to on most of the April-planted cotton, and even then weevil damage was considerable in some instances.

THE AFTERNOON METHOD OF WEEVIL CONTROL

The use of the "Afternoon Method of Control" is very simple and economical. A poisoned syrup mixture is made by mixing one pound of Calcium Arsenate in a half gallon of water, and then stirring in a gallon of syrup. The mixture is then applied to the cotton by means of a hand mop in the afternoon when the plants are dry and the weevils are thirsty. When nights are cloudy and no dew forms poisoning may be done in the forenoons. Weekly applications are made until all weevils are out of winter quarters, about June 10-12 around open pine woods, and about June 18-20 near swamps. The poisoning program will require five or six applications where the cotton grows rapidly and begins to square early, and about four applications where it grows slowly and begins to square somewhat late.

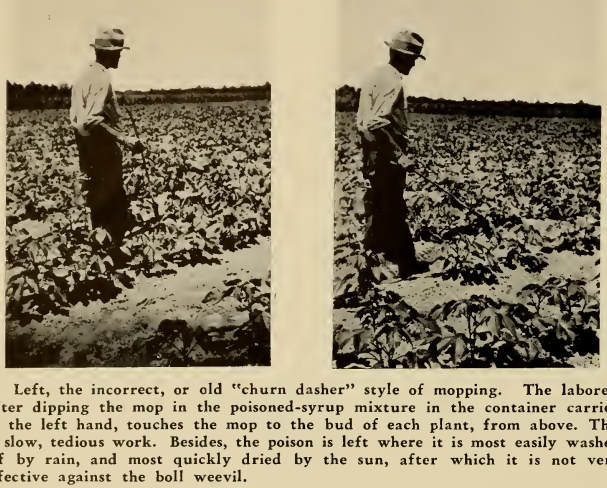
A cheap No. 2 grade cane syrup should be used where obtainable. Insects, like the higher animals, have definite tastes. The square and the blossom, which are distinctly sweet, are the boll weevil's preferred foods in nature. The weevil, therefore, will feed more freely on a good grade of syrup than on a bitter syrup, such as black strap molasses. If the latter is used, better results will be secured if it is mixed with No. 2 cane syrup, the larger the proportion of cane syrup the better. One gallon of cane syrup to two gallons of molasses, however, has been found to give good results. Excellent results have been secured, under certain conditions, with plain black strap.

The mop is made by wrapping a piece of burlap about the size of a small handkerchief around the end of a small stick approximately 36 inches long, tying securely with twine, and slitting the protruding end several times with a knife blade. About four inches of the roll should protrude beyond the end of the stick.

The success or failure of the poisoning method will depend largely on the manner in which the mopping operation is carried out. The Sea Island grower who uses this method should take pains to learn the proper way to mop a cotton plant, otherwise, he will almost surely be disappointed in the results.

The mopping operation should be carried out at a steady walk. Momentary pauses are made while dipping the mop only. The mop, after it is dipped in the pail containing about a half gallon of the mixture, is held somewhat loosely in the hand, the handle inclined slightly forward. While walking forward, the wet mop is pushed through the tops of the plants, applying the poison to the main stems and limbs near the top, and the undersides of the leaves surrounding the bud. If the mop is dipped every forty feet or so, and held so as to strike the plant just beneath the bud the poison will be applied with its most telling effect. Boll weevils crawl about the plants, so poison applied to the upper limbs and main stems will be found quickly. In these locations, too, the poison is shaded, and therefore remains in liquid form much longer than if placed on the upper sides of the leaves.

Fig. 7. The Mopping Operation, showing the correct and the incorrect procedure.



Left, the incorrect, or old "churn dasher" style of mopping. The laborer, after dipping the mop in the poisoned-syrup mixture in the container carried in the left hand, touches the mop to the bud of each plant, from above. This is slow, tedious work. Besides, the poison is left where it is most easily washed off by rain, and most quickly dried by the sun, after which it is not very effective against the boll weevil.

Right, an improved procedure for mopping cotton. The wetted mop is simply pushed through the tops of the plants while the laborer walks full speed ahead. The tops of the plants are pushed over, and the poisoned-syrup mixture is applied to the under sides of the leaves, and to the limbs and main stem of the plants. It is much better protected from rain and sun in these locations, and therefore remains potent for a longer period of time. In addition, only about half the labor is required for applying the poison in this manner as in the old "churn dasher" style of mopping.

The most common mistake the inexperienced operator makes in mopping cotton is walking too slowly, and trying to give special attention to individual plants, thinking the plant is inadequately poisoned unless the poison is visible from above. On first glance, a properly mopped cotton plant looks like it has no poison on it. Close examination, however, will reveal an adequate amount of poison under the topmost leaves, and on the upper limbs. The operator does not need to worry about whether poison is being left on the plants if the mop is frequently dipped into the syrup mixture, no matter how fast he walks, or how short the time of contact between the mop and plant. It is a physical impossibility to touch a plant with a saturated mop without leaving poison on it.

The amount of material used is governed by the size of the mop, and the frequency with which it is dipped. When the cotton is small, a comparatively small mop should be used, so as to apply about a gallon to one and one-half gallons of the mixture per acre. As the cotton increases in size, larger mops should be used. Towards the end of the mopping season, about two gallons of mixture per acre are used for one mopping. The average for the season should be about a gallon and a half of mixture per acre per application, or an average of one gallon of syrup and one pound of poison per acre per application.

In case a light shower occurs an hour or so after the mopping is completed, the plants should be examined to see if any considerable quantity of the poison was washed off. If it was, it should be reapplied as soon as the plants are dry. If, however, no rain occurs inside of three hours, reapplication of the poison is not necessary unless the cotton is known to be heavily infested with weevils.

The seven-day time interval for mopping is based on a knowledge of life history of the over-wintered weevils. As was explained earlier, over-wintered weevils do not begin to deposit eggs immediately upon entering the cotton field, but must feed for about a week before eggs mature. It is safe to allow over-wintered weevils to remain in the field five or six days, therefore, for during that time no new brood will be started. If they are allowed to remain in the field more than a week, however, eggs will be deposited in the squares, and a new generation of weevils will have to be dealt with after the over-wintered weevils are killed. Growers from time to time have skipped a week during the poisoning season, thinking it would make but little difference, only to find that it was necessary to make several poison applications later in the season in place of the one missed, in addition to going to considerable trouble to pick up fallen weevil-punctured squares.

After the end of the mopping season and during the latter part of June and the first part of July, a careful examination of the field should be made from time to time for any weevils that might have been, for one reason or another, missed by the poison. Where an infested spot is found, the spot should be "flagged" by sticking up a marker. All punctured squares should be picked up and burned and the infested area should be poisoned by a method described later as "slinging."

Fig. 8. Making sure that the hibernated weevils have been completely eliminated. WPA Field Assistants examining a field of Sea Island Cotton at the end of the poisoning season. Note the dense woods at the border of the field.

PICKING UP SQUARES

If, due to unfavorable weather, some of the poison applications are omitted or not made on time, or the first application is not made until squares are punctured, a considerable number of weevil-punctured squares will be found during the latter part of the poisoning season. These should be carefully picked up and burned, otherwise weevils will hatch and seriously damage the crop unless several extra applications of poison are made under favorable weather conditions.

SLINGING

Ordinarily, if properly poisoned from the time squares appear until hibernated weevils cease to enter the field, early planted Sea Island cotton will mature a full crop without further attention. However, if the cotton matures late for any reason, such as too heavy soil, too much rain, or too late an application of nitrogen, weevils may migrate into it from unpoisoned cotton before the bolls are safe from attack. If the summer weevil migration is excessively heavy, such as might be experienced if the poisoned field is in the immediate vicin-

ity of a large acreage of unpoisoned upland cotton which "breaks down" and forces an early migration, the situation is a difficult one to deal with. Such weevil migrations, however, are not common in Florida. The first part of the summer migration in Florida, is usually comparatively light, and can be suppressed by three or four "slingings" with the same mixture used for mopping provided dry weather conditions prevail.

The term "slinging" is fairly descriptive of the operation itself. This method of poisoning was originated in Madison County by one of the WPA assistants*, and has been used successfully in that county for several years.

A small mop is used, with a short, flexible handle. The tip of the mop is saturated by being dipped in the mixture, and, by a movement of the wrist and forearm, the mop is swung in a part circle first to one side of the operator, then to the other, above the cotton plants, so the plants on several rows to each side are sprinkled with droplets of the mixture. A little practice is necessary to learn to perform this operation effectively, but after it is learned, large cotton can be poisoned very rapidly. The poison falls in droplets on the leaves, bolls, squares and limbs, while, of course, some falls on the ground. If a gallon and a half to two gallons of the poison mixture are used per acre, the weevils are considerably reduced in numbers. An examination of the top bolls in both slung and unslung fields in Madison County in 1938, several weeks after the summer migration had begun, showed that the immature weevil forms in the top bolls of the unslung cotton were, on an average, about two weeks older than those in the slung cotton. In other words, the slinging method of midsummer poisoning gave the plants an average of two weeks longer to produce cotton. In the fields planted somewhat late, this was a considerable help, as a large proportion of the crop was still in the weevil damage susceptible stage when the summer migration began. Very likely the yield in some of the late planted fields was increased fifty percent or more. In the early planted fields, however, slinging did not materially increase the yield, as most of the bolls were past the susceptible weevil-damaging stage when the summer migration began.

The above remarks should not be construed to mean that poisoning the weevils by slinging will control any summer migration for a period of two weeks. Under some conditions, it probably would not control migratory weevils two days, while under some other conditions it probably would control them

*C. L. Milford.

until frost. The summer migration of the weevil is nothing more or less than an exodus from fields where the cotton has, for one reason or another, become unattractive to it. Perhaps it is because weevils have become so numerous that all squares and bolls have been punctured, forcing the females to seek clean squares and bolls elsewhere for laying purposes. It may be because the cotton has ceased to square, and has shed all its tender bolls. This is frequently the cause of a migration from upland cotton. Heavy early summer migrations are to be expected in communities where a considerable acreage of unpoisoned upland cotton is found. In such communities, migratory weevils are often so numerous around July 25 that it is almost an impossibility to control them.

Florida conditions, however, do not in general produce excessively heavy summer migrations of the weevil until reasonably late in the season, because the acreage planted to cotton is comparatively small, and well scattered. Under such conditions, slinging can be expected to pay best. If slinging were tested by the small plat method, whereby an acre of weevil-infested cotton is divided into, say, tenth-acre plats, with the small slung plats located adjacent to unpoisoned cotton, it, no doubt, would make a very poor showing. Numerous reports have been published where the mopping method of control, tested in this manner, failed to control the weevil. Yet mopping has, four years in succession, satisfactorily controlled the weevil on Sea Island cotton in Madison County, which had never ceased to grow upland cotton, and therefore had a good supply of weevils on each of the four years. In our opinion, the small plat method of testing weevil control methods is not a reliable indication of the worth of a control method when it is to be used on a field-wide basis in more or less isolated plantings such as are commonly found in Florida. It would follow that it would be a still poorer indication of the worth of a control method when used on a county-wide or state-wide basis, although, of course, the small plat method of testing has much to commend it as a means of evaluating a control method that is to be used in communities where no isolation from unpoisoned cotton is possible.

We feel, further, that considerable injustice has been done the mopping method of control by publishing "averaged" results, wherein some of the plats included in the average were under conditions inherently unfavorable to the mopping method of control. Perhaps some of the test plats were located where an abnormally late emergence of the weevil was to be expected, and poisoned an insufficient number of times to take care of this unfavorable factor. The most common unfa-

Library
N. C. State College

vorable factor in such tests, however, has been the location of the mopped plats in such a way that they would suffer from migratory weevils to a much greater extent than would have been the case had the entire acreage been mopped.

EARLY FALL DESTRUCTION OF THE COTTON PLANTS

Early fall destruction of the cotton plants as a means of reducing the following year's supply of weevils has been recommended almost from the time the boll weevil entered the United States. For one reason or another, it has never been practiced extensively. Florida conditions are such, however, that more benefit can be derived from early stalk destruction than in most parts of the Belt. Even in the northern part of Florida, cotton can be planted and gathered earlier than in most parts of the Cotton Belt. This, in conjunction with the late fall often experienced, makes it practicable to force the weevil to live through a month or more of warm weather without food before entering winter quarters. If early fall destruction of the cotton stalks was practiced in Florida very few weevils would survive to attack the next year's crop, and those surviving would emerge from hibernation comparatively early in the summer, making it unnecessary to poison more than three times to completely eliminate them.

In the more southern part of the Sea Island producing area of Florida, conditions are even more favorable for controlling the weevil by early fall destruction than in the northern part of the State. The earlier plantings possible there, in connection with the warmer and later falls, make it feasible to force the weevil to go through a still longer warm period without food before entering winter quarters than is possible in the northern part of the State. Were full advantage taken of this fact, it is doubtful if any poisoning at all would have to be resorted to even as far north as Ocala. In regions as far south as Tampa or Melbourne it is a virtual certainty that early stalk destruction alone would so reduce weevil numbers as to permit the production of a full crop of cotton the following year without the use of poison.

Not only is it true that the farther south cotton is planted in Florida the more benefit will be derived from early stalk destruction, but the converse is true, that is, the grower will be penalized for not destroying stalks as early as feasible. Live upland cotton has been found around Gainesville in January, and sometimes it occurs throughout the winter. Sea Island cotton tends to sprout during warm weather unless a very severe freeze has occurred, so possibly from Gainesville south,

and certainly from Ocala south, live basal sprouts in many of the Sea Island cotton fields will be comparatively common throughout the winter. This complicates the problem of weevil control and the following year's weevil supply will be greatly augmented by these fields. Moreover, in many instances weevils will migrate from stubble fields into the young cotton during a period in which it otherwise would not have to be poisoned, the latter part of June or the early part of July, for instance. It can almost be said with safety that the early destruction of the cotton stalks will not only be very beneficial in the southern part of the Florida Sea Island Belt, but that it will be a practical necessity once the boll weevil becomes well established there.

NATURAL CONTROL

It has been estimated that the progeny of one pair of weevils in a single season would be 12,755,000 individuals if nature had not provided several means of preventing excessive multiplication. The most effective of these are the extremes of temperature and insects that prey upon the weevil.

LOW WINTER TEMPERATURES

Low winter temperatures, in the northern part of the Cotton Belt, probably give more protection against the boll weevil than any other factor. In Florida, however, this is not the case. Even in the northern tier of counties, winters are never severe enough to be of major importance.

In the lower Sea Island producing counties, the unusually warm winters are an important factor in reducing the weevil population. During long warm periods the weevils become active, and, if no cotton is available for food, soon die.

HIGH SUMMER TEMPERATURES

High summer temperatures, on the other hand, are an important factor of natural control in all parts of the State. During the ten to twelve days that the immature weevil lives in the square on the ground, heavy mortality is produced by high temperatures. Sometimes practically an entire generation of immature weevils is wiped out by hot sunshine. In Florida it is the most important single factor of natural control.

PARASITES

The boll weevil has a number of natural enemies in Florida. Several parasites deposit eggs on the immature weevil stages in squares. The young parasites that hatch feed on the immature weevil stages and kill them. Parasites, however, do not destroy a very large percentage of the boll weevils in Florida.

PREDATORS

Several predacious insects attack the boll weevil, chiefly in the immature stage. By far the most important of these are several species of ants, which chew into the square and destroy the immature weevil. In some instances, ants are an important factor in the control of the weevil, but ordinarily they do not attack the weevil-infested squares until comparatively late in the season, after it is too late for the crop to be benefited.

THE ANNUAL SUMMER RAINY SEASON

Profitable production of Sea Island cotton under Florida conditions is complicated by the long, annual summer rainy season. As a general rule, the wet season begins about July 1 and lasts from four to six weeks. During the rainy season the time interval between weevil generations is shortened and the annual summer migration occurs. This condition prevents successful control of migratory weevils by the use of poisons, increases boll rots and otherwise prevents profitable yields on all cotton except that planted extremely early. WPA Entomologists have tested dusting, spraying and mopping during the wet season for control of migratory weevils. In the hands of experts midsummer poisoning operations have shown a profit, but the operation is too complicated to recommend for use by the average grower.

Fig. 9 shows graphically the average annual distribution of rainfall for the state as a whole. It is apparent that the winters are definitely dry, while the summers are wet. If a good crop of bolls has not been practically matured by the time the rainy period arrives, the plants grow excessively and mature the crop late. Also, weevils multiply very rapidly during wet weather, and since there is no practicable method of controlling this insect during excessive wet weather, the crop is heavily damaged.

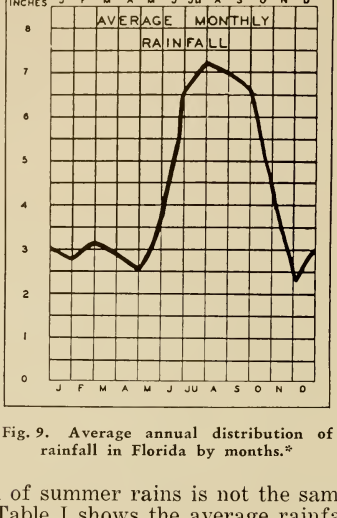


Fig. 9. Average annual distribution of rainfall in Florida by months.*

The problem of summer rains is not the same for all parts of the State. Table I shows the average rainfall, by months, over a period of years, of four points in the northern part of the State, as compared to the average rainfall of four points in the central and southern parts of the State.

Table I. Average Rainfall, by Months, Over a Period of Years at Ft. Pierce, Ft. Myers, Tampa, and Sanford, as Compared to the Rainfall, by Months, at Pensacola, Marianna, Tallahassee, and Lake City.†

MONTH, AND PRECIPITATION IN INCHES

Group—Northern or Southern	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Southern Group	2.60	2.35	2.48	2.38	3.73	7.40	7.35	7.00	6.63	4.73	2.03	2.10	50.78
Northern Group	3.95	4.43	4.38	3.43	3.65	5.73	7.23	6.65	5.35	3.25	2.88	4.35	56.28

Table I shows that during June, July, August, September and October, the northern group of stations received 4.9 inches *less* rainfall than the southern group, whereas during the re-

*From *A Graphic Review of Florida Agriculture.* Bulletin 99. New Series, Florida Department of Agriculture.

†Data from *The Climate of Florida.* A. J. Mitchell and M. R. Ensign. Bulletin 200, Florida Agricultural Experiment Station, November, 1928.

maining months, viz., November, December, January, February, March, April and May, the northern group received 10.40 inches *more* rainfall than the southern group.

Obviously, when the boll weevil becomes established in the southern part of the Florida Sea Island Belt, it will be just as necessary to secure early maturity of the crop as it is in the northern part of the Belt, if not more so, as the summer rainfall is more intense there. The solution, of course, is early planting, in conjunction with other cultural practices which promote early maturity of the crop.

CULTURAL RECOMMENDATIONS FOR GROWING SEA ISLAND COTTON

In addition to controlling the weevil by the use of poison there are other practices which aid in reducing weevil damage and must be put in use by Florida growers. Sea Island cotton cannot be grown successfully unless the grower understands from the beginning that he is producing the world's finest staple and as such must give it extra care and attention. If proper cultural practices are not followed, in addition to the poisoning program, disappointment is almost sure to result.

SEED STRAINS

The origin and history of Sea Island cotton is interesting, as showing how the cultivation of choice crops in suitable areas may yield rich returns. Concerning the distribution of Sea Island cotton we quote Dr. Walter H. Evans as follows:

"Long fibered Sea Island cotton is indigenous to the Lesser Antilles, and probably to San Salvador, the Bahamas, Barbados, Guadaloupe, and other islands between 12 and 26 degrees north latitude. By cultivation it has been extended throughout the West Indies, the maritime coast of the Southern States, Central America, Puerto Rico, Jamaica, etc., southern Spain, Algieria, the islands and coast of western tropical Africa, Egypt, Island of Bourbon, East Indies, Queensland, New South Wales, etc. It may be cultivated in any region adapted to the olive and near the sea, the principal requisite being a hot and humid atmosphere is not entirely necessary if irrigation be employed, as this species is undoubtedly grown extensively in Egypt."

Before the advent of the boll weevil there were several so called different strains of Sea Island cotton grown in the Southeastern Belt. Among them might be mentioned such well known strains as white and yellow Canova; Sosnoski and Seabrook. Each strain had certain peculiarities; some with lint a little longer than others; some with larger bolls; some more prolific; and some strains difficult to pick. Seabrook, on account of the sharp ends of the open bolls, has always been one of the most difficult of the strains to pick. Some of the strains were of very poor quality, having short, coarse, uneven lint, and some were of high quality, having long, fine, even lint. All Sea Island strains grown then were, however, slow maturing.

When the boll weevil drove Sea Island cotton from commercial production about 1920, the U. S. Bureau of Plant Industry selected a number of the more desirable strains of Sea Island seed, and began making selections for their improvement. Practically all seed available now are from a Seabrook selection, a few bushels of seed which were sent to Trenton and Gainesville, Fla., in 1934. The Seabrook selection seemed, all things considered, to be the most promising one, as it combined high quality long lint with earliness of maturity.

Poor strains of seed are, however, being offered for sale. In some instances they are Seabrook seed that have been allowed to become contaminated with upland cotton. In other instances they are selections made by plant breeders who bred for earliness of maturity and ease of picking, losing sight of the necessity for maintaining quality and length of lint. The U. S. Burenu of Plant Industry is going to considerable expense to insure good planting seed. Better strains, from time to time, no doubt, will be offered and Sea Island growers are urged to plant only those strains approved by the U. S. Bureau of Plant Industry.

NECESSITY FOR PURE SEED

Not only should care be exercised to secure a desirable strain of seed—one that is inherently of good quality, but every effort should be made to prevent them from becoming contaminated with upland cotton. All fields from which planting seed are selected should be carefully "rogued" during the growing season, that is, all off-type or mixed plants should be pulled out. Since crossing occurs between blossoms, as many of the off type plants as possible should be destroyed before blossoms occur, or as soon afterwards as

possible. The removal of mixed plant after large bolls have developed is, of course, worth while, but it is best to remove them while small. The remaining plants produce better and the seed are improved for they do not become contaminated by pollen from hybrid plants.

Mixed plants can be recognized with a little practice. They usually have a broader, greener leaf, and a fuzzy bud. The squares are usually larger and more stocky, and generally three dots will be found on the base. These dots are seldom present on pure Sea Island squares. The contents of large Sea Island squares are a deep yellow, and of most hybrid squares a light yellow. The blossoms of Sea Island cotton are deep yellow, with a purple coloration inside at the base of the blossom, while upland cotton blossoms are white.

A practical procedure for a farmer who wishes to save planting seed is to select an area in the field where the cotton appears to be least mixed, and rogue that area very thoroughly, pulling up every plant that is off-type. The cotton from this area should be harvested and ginned separately. The next best procedure is for the farmer to inspect a number of his neighbor's fields during the growing season, and buy seed from one that has an unmixed strain.

Date of Planting

Too much emphasis cannot be placed on the necessity of planting Sea Island cotton as early as possible. The crop must be made before the summer migration of the weevil begins. It is practically impossible to produce an early crop of Sea Island cotton that is planted late.

In the northern part of the Sea Island Belt, if Sea Island cannot be planted by March 25, it should not be planted. As far south as Ocala, it should be planted by March 1. In the more southern counties, such as Brevard and Hillsborough, it should be planted by Feb. 15. These are the latest planting dates recommended. If weather is suitable, it should be planted earlier.

In case a killing frost occurs after the cotton is up, it can be planted over. In such an event, all cotton will be late, and consequently the summer weevil migration will also be late, leaving the second planting of Sea Island at no disadvantage. However, if half the upland and Sea Island plantings are made by March 20, and the remainder around April 1, the late-planted Sea Island will have two weeks less in which to produce cotton than it should have, because of the weevil migration from the early plantings.

FERTILIZATION

Proper fertilization is an important factor in the growing of Sea Island cotton under weevil conditions, not only from the standpoint of causing the plants to put on and mature a good crop of bolls, but also for securing earliness of maturity. Unfertilized Sea Island cotton will suffer from summer weevil migrations to a considerably greater extent than properly fertilized Sea Island cotton.

It is impossible to make inflexible recommendations for the proper composition or amount of fertilizer best to use. No two plats of ground are exactly alike, and no two seasons are alike. Since on the average Florida farm a wide range of soil conditions are found, it is impossible to give any one formula as the best to use. The following general principles, however, should be useful as a guide in laying out the fertilization program.

Most light soils in Florida are deficient in potash, and this element should be used liberally. Phosphate is an essential plant food element, and its liberal use is seldom a mistake, especially since most of the phosphate that is not used by the crop to which it is applied remains in the soil for succeeding crops.

Nitrogen should be applied only in quantities sufficient to secure the plant growth needed. On light soils a considerable amount of this element is usually needed. On heavier soils, less will be required. However, it should be remembered that even on light soils too much nitrogen can easily be applied. The water holding capacity of Florida sandy soils is very low. Soil moisture studies in Madison county in 1936 demonstrated that if excessive plant growth is forced by heavy nitrate applications, excessive shedding will result if the fruiting season is dry. Balance in fertilization, as in most other things, is the safest policy.

Fertilizer tests on Sea Island cotton—conducted by the WPA in Madison county in 1936 and 1937, indicated that on light sandy Norfolk soil, about 200-300 pounds per acre of a fertilizer approximating a 5-7-5 or 4-10-6 analysis at planting, and a side dressing of about 75 pounds per acre of nitrate of soda, or better, a combination nitrate and potash side dressing, such as a 9-0-15 or 9-0-12, appeared to be about the safest practice. On somewhat heavier soils in the shallow bottoms, the side dressing showed less profit, but the heavier applications of the general formula applied at planting paid well, whereas they did not on the light soils.

In other words, it appeared that, within reasonable limitations of course, the more fertile the soil, the more fertilizer it paid to use.

It is not best to try to follow a calendar program in the use of fertilizer, especially side applications. Probably the most profitable use to which nitrate of soda can be put is in "snapping" the young cotton out of a setback induced by cold weather. Fifty or sixty pounds of nitrate of soda applied when the young cotton first shows signs of stunting will pay handsomely. This use of nitrate of soda is extensively practiced in the more northern parts of the upland Cotton Belt, and no doubt can be used to good advantage by the Florida Sea Island grower, who must plant early, and therefore run some risk of having the young cotton stunted by early April cold snaps.

SPACING

No inflexible rule can be laid down as to proper spacing. There is, of course, a "best" spacing, just as there is a "best" fertilizer formula, but like the latter it will vary with the soil type and with the season. Fortunately, incorrect spacing makes little difference in the yield, so long as it is approximately right. If sixteen inches in the drill gives the best yield, any spacing between fourteen and twenty inches will give almost as good yield.

On the average grade of Norfolk sandy soil planted to Sea Island cotton in Florida, sixteen inches in the drill in four foot rows appears best. On heavier soils, the width of rows should be increased to four and a half or five feet, and the spacing in the drill increased to 20 to 24 inches.

TOPPING

Many Sea Island growers break the buds out of the plants, after the cotton has reached the height desired, in order to force earlier maturity of the bolls already set by the plants. Experiments in topping conducted by the WPA in Madison county in 1936 failed to show any advantage in this practice. The untopped rows yielded as well as the topped rows. The topped rows were, however, on sandy soil. Topping might be some advantage on heavy soil where the plants tend to grow too large, thus causing excessive rotting of the bottom bolls.

Fig. 10. Unfertilized cotton, left, and fertilized cotton, right, of the WPA fertilizer, spacing and topping test, Madison county, 1936. Both plats were planted at the same time and cultivated alike. The fertilized cotton not only made a much higher yield, but matured the bulk of its crop ten days or more earlier than the unfertilized cotton.

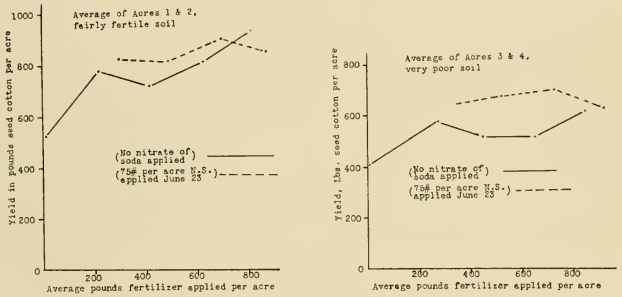


Fig. 11. Graph showing average yields of the two most fertile acres (left) and the two poorest acres, (right), of the WPA fertilizer test, Madison county, Fla., 1936.

On the fertile plats, heavy applications of 4-8-4 at planting gave good returns, whereas the side application of nitrate of soda gave poor returns. On the lighter soil, heavy applications of 4-8-4 at planting gave poor returns except where it was supplemented by a side application of nitrate of soda.

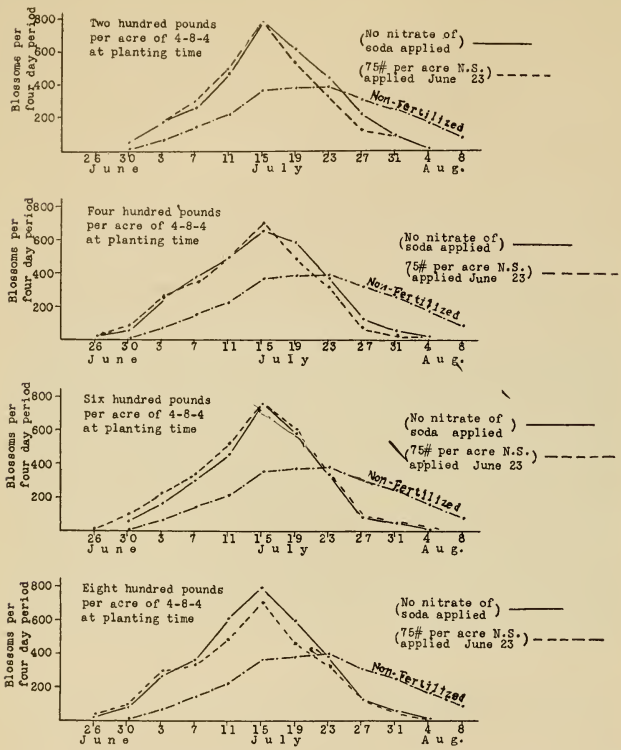


Fig. 12. Average rate of blossoming for different rates of fertilization on fertile soil in WPA fertilizer test in Madison county, 1936.

The fertilized cotton blossomed rapidly over a short period of time, setting an early crop of bolls. The unfertilized cotton blossomed slowly over a long period of time, setting its crop late. Boll weevil control was much easier on the fertilized cotton than on the unfertilized cotton.

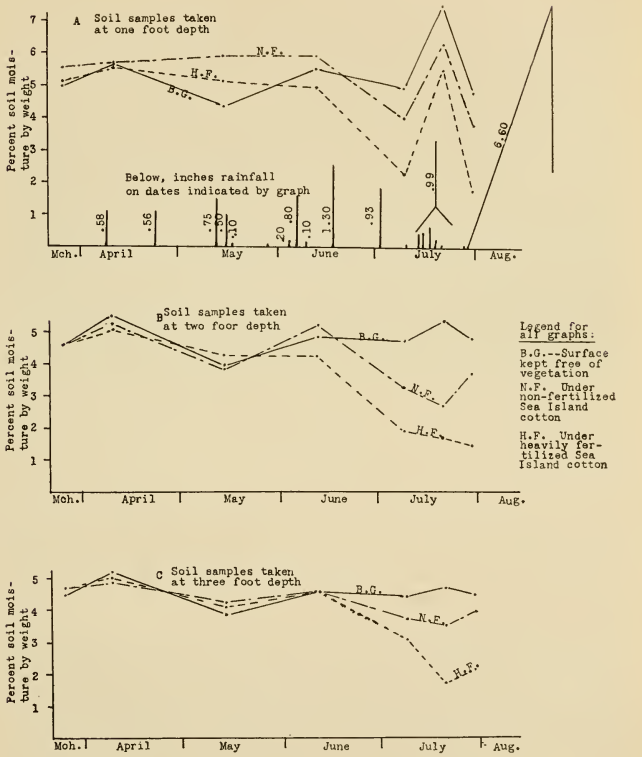


Fig. 13. Percentage of soil moisture during the growing season at one, two, and three foot depths under bare ground, non-fertilized Sea Island cotton, and heavily fertilized Sea Island cotton on various dates, in the WPA fertilizer test, Madison county, 1936.

The soil moisture supply was practically exhausted on the heavily fertilized plats (H. F.) at all depths early in July. Under the non-fertilized (N. F.) cotton the soil moisture supply was not exhausted at any time during the season. The heavily fertilized cotton wilted very badly during most of July, while the unfertilized cotton did not wilt at all.

Moisture percentage was determined by weighing before and after heating. Soil with 2% moisture felt dry to the touch, and obviously furnished the plants very little water.

MISCELLANEOUS PESTS OF SEA ISLAND COTTON

THE COTTON LEAF WORM *(Alabama agrillacea)*

The cotton leaf worm, commonly called the cotton caterpillar, ordinarily attacks cotton in Florida during the latter part of September or the first part of October. If the attack is severe, all foliage is destroyed in a few days after the pest appears. Some of the immature bolls are ruined, but very few grown bolls are damaged. This insect therefore does no damage in Florida except possibly on exceptionally late cotton in the southern part of the Belt. Since late planting is questionable practice even in this part of the Belt, it is felt that the leaf worm is a practically harmless insect in Florida. However, if it attacks cotton early enough to endanger an appreciable part of the crop, it can easily be controlled by dusting with calcium or lead arsenate. A light application of either of these poisons will so reduce the caterpillars in numbers that the bolls will not be attacked.

In the northern part of the Sea Island Belt, complete defoliation by the leaf worm will considerably reduce the initial weevil infestation the following year. Partial defoliation, however, will have little effect on the weevil population.

The cotton leaf worm is the larva of a night flying moth, which does not survive the winter in Florida, but migrates in from the West Indies each year. The moth feeds principally on flowers and fruits, and is sometimes found in the northern part of the United States in the fall. The larva, or leaf worm, feeds only on cotton.

Fig. 14.—Two typical Sea Island cotton fields, in which defoliation by the leaf worm was practically complete. Note that all foliage was eaten even from the tips of the limbs and the tops of the plants. Wherever defoliation was as complete as here shown, the boll weevils soon migrated and no new brood was hatched. The foliage in both fields was dense prior to the leaf worm attack, which occurred about September 25.

THE COTTON BOLL WORM *(Chloridea obsoleta)*

Occasionally an outbreak of the cotton boll worm occurs and considerable damage results. A hole is eaten from the outside of the boll and the contents are consumed. This insect is also a serious pest of tomatoes and corn, being known as the tomato fruit worm or corn ear worm when it attacks these crops.

The boll worm is a much more serious pest in some localities than in others. Where it is known to be a menace, close watch should be kept for its appearance, and the cotton dusted with calcium or lead arsenate when it appears in damaging numbers. Usually only the rankest spots need dusting.

APHIDS

Cotton is sometimes more or less severely attacked by aphids, usually when it is young. The usual procedure for controlling aphids, however, are so expensive that it does not pay to apply them to cotton. Generally aphid infestations on cotton are eventually controlled by natural agencies in time to prevent serious damage to the crop.

CUTWORMS

Cutworms will be found troublesome on cotton under the same conditions that they are troublesome on other crops. After turning under grass land a close watch should be kept for cutworms. If they are found to be numerous, they should be poisoned with one of the several baits in common use. Probably the most commonly recommended formula consists of:

Bran	20 Pounds
Cottonseed meal	5 Pounds
Paris Green	1 Pound
Water	2½ Gallons

Some recommend syrup or molasses in addition to the above, and some use arsenate of lead instead of Paris green. Probably five or six ounces of sodium arsenate in 25 pounds of bait would be found equal to, if not superior to, either.

If the cotton is up, or coming up, when cutworms are first noted, the bait should be spread on the ground along the drill late in the afternoon. If a field is known to be infested with cutworms, it is best to broadcast the bait a week or so after breaking the land, or at any rate, before the cotton begins to come up.

THE RED SPIDER *(Tetranychus telarius)*

In some localities, a small mite called the red spider attacks cotton, causing a yellowing of the leaves by sucking the juices of the plant. Considerable webbing will be found on the under sides of the leaves on heavily infested plants.

If this pest threatens to do serious damage, it can be controlled by the application of lime sulphur dust, or even plain flowers of sulphur.

THE COTTON STAINER *(Dysdercus suturellus)*

Prior to the arrival of the boll weevil, the cotton stainer was one of the principal pests of Sea Island cotton in Florida. Lint from bolls sucked by this insect is stained and of inferior grade. At one time it was thought that the stain was caused by a secretion of some sort, produced by the insect, but it is now thought to be caused indirectly by leakage from the immature seed that have been pierced by the sucking tube of the stainer. Both adults and nymphs will cause the stain. If care is not exercised in picking stainer-infested cotton, the insects will be picked with the cotton, and subsequently crushed by the gins, which will further damage the lint.

DESCRIPTION AND LIFE HISTORY

The adult stainer is a dull red insect about $\frac{5}{8}$ of an inch long, and a little less than half as broad. Markings on the wings form a characteristic X on the adult insect's back when they are folded. Prominent white crosswise stripes give both the adults and nymphs a rather distinctive appearance.

The stainer passes the winter in both the adult and nymphal stages. It feeds on a wide variety of plants, but apparently multiplies much more prolificily on some foods than others. In discussing the stainer, one text book on entomology states: "Since cotton seed has become almost as valuable as cotton itself, and is now completely used up, it has been found that these insects have become practically harmless. It seems that they were enabled to multiply unduly in heaps of decaying cotton seed, and since at present no such heaps exist they cannot increase so rapidly."

Adult stainers move into cotton more or less gradually from surrounding host plants which die or otherwise become unsuitable as food. They feed on all parts of the cotton plant, but appear neither to multiply rapidly or do much dam-

age until bolls begin to form. Soon after bolls appear, however, egg-heavy females will be seen crawling about the ground seeking suitable places for egg deposition. The eggs are deposited in masses of 50 to 100 on the ground, usually under the plants, and are covered with a little trash or sand. In about a week the small nymphs emerge, and a few days later begin crawling up the plants. During the first few days, the small bright red nymphs tend to feed on tender basal sprouts if these are available, but soon they will be seen crawling about all parts of the plants, feeding on the squares, blossoms, and tender bolls, as well as the vegetative parts of the plants.

During the summer, the nymphal stage lasts from 30 to 40 days. An entire generation, therefore, requires approximately 40 days for completion under summer weather conditions. Cool weather will considerably lengthen this period.

CONTROL

In the parts of the Sea Island Belt where stainers appear in damaging numbers, active control measures are advisable. In many instances cultural methods of control will suffice, but in others cultural practices will have to be supplemented with more positive control measures. Fortunately, most of the cultural methods of stainer control will be found beneficial in the control of the boll weevil and most other cotton insects.

TYPE OF SOIL TO PLANT

In stainer-infested areas only those soils should be planted extensively to Sea Island cotton that have been found to set and mature a reasonably early crop. Heavy, damp acid soils (pH 5.5 or less) so far have been found unsatisfactory for Sea Island cotton. In an exceptionally dry year such soils, if not too acid, might produce a good yield, but in general Sea Island cotton planted on heavy acid soil produces too much weed and the bolls remain soft too long. Not only the stainer, but numerous other pests, damage the bolls on rank succulent cotton much more severely than where the bolls harden in a short while after they reach full size. Aiming for early maturity of the bolls is the first and probably most important consideration in planning a control program for almost any of the many insect enemies of cotton, to say nothing of boll rots which often cause more damage than insects on rank, slow maturing cotton.

DESTRUCTION OF HOST PLANTS

All known wild or otherwise worthless host plants of the stainer in the neighborhood of cotton should be destroyed, although at present little is known concerning the part played by plants in carrying stainers through the winter in the Sea Island Belt of Florida.* In the southern part of the Belt, Caesar weed *(Urena lobata)* is undoubtedly one of the principal wild host plants. (See Fig. 15.) The principal wild host plants in the northern part of the Belt are not known. Where Sea Island cotton is established, however, old fields of Sea Island cotton will undoubtedly be an important factor in carrying stainers through the winter. All Sea Island stalks should therefore be destroyed as soon as the cotton is picked. If it is not practicable to destroy the stalks as soon as the cotton is picked, they should by all means be destroyed before cotton is planted the following year.

*In the Melbourne area in the fall of 1938, stainers were observed feeding on isolated specimens of: Caesar weed, *(Urena Lobata)*; Turk's Cap, *(Malvaviscus grandiflora)*; and ornamntal hibiscus *(Hibiscus rosa-sinensis* L.) In the vicinity of cotton or Caesar weed they were observed feeding on: Shepherd's needle *(Bidens pilosa* L.); groundsel bush *(Baccharis halimifolia)*; tea weed *(Sida carpinifolia* L.f.); golden aster *(Heterothecea subaxillaris)*; a specie of ragweed *(Ambrosia monophylle)* (Walt.) Rydb.; *Euthamia monor*; several species of golden-rod, and a number of other plants not submitted for identification. Plant identifications by courtesy of Dr. A. S. Rhoads, Lilian E. Arnold, and Erdman West, of the Florida Agricultural Experiment Station.

Fig. 15. *Urena lobata*, sometimes known as Caesar weed, one of the common wild host plants of the cotton stainer south of Ocala. Notice the branching characteristic of the plant. Leaves are dark green, from three to four inches across, almost round. Blossoms are about a half an inch long, slightly pink. The fruit is a five-sectioned bur about one-fourth an inch across, with one small round seed in each section. This plant grows in fertile, somewhat moist situations.

POSITIVE MEASURES OF STAINER CONTROL

In stainer infested territory close watch should be kept for stainers from the time cotton blossoms appear. If they are found in considerable numbers before the cotton begins to open, active measures should be taken to reduce their numbers. Several means of doing this are at the disposal of the cotton grower.

HAND PICKING

If stainers are not particularly numerous, hand picking may suffice to prevent them from doing appreciable damage. The adults are gathered by hand and dropped in a pail or can containing kerosene. In many instances, if the can is held under the plants the stainers can be jarred into the kerosene rather easily.

PYRETHRUM SPRAYS

Some workers report satisfactory control of the stainer can be secured by spraying the colonies with pyrethrum sprays, using a hand atomizer. This probably is feasible where the cotton foliage is comparatively thin so the colonies of insects may be easily seen and reached by the spray. With both hand-picking and with pyrethrum sprays, however, considerable diligence is required. The "mother brood" should be eliminated, insofar as is possible. Neither method is feasible after stainers become very numerous and well dispersed through the cotton.

POISON BAITS

If stainers appear in too large numbers and are too widely dispersed through the cotton to permit their control by either of the above methods suggested, they can usually be sufficiently reduced in numbers by the use of a poisoned bait.

The bait found most successful consists of a sweetened water solution to which one ounce of sodium arsenate per gallon of solution is added. The water may be sweetened with sugar or table syrup, but black strap molasses is unsatisfactory for this purpose. Two pounds of sugar or one quart of syrup per gallon of poisoned solution appeared to give satisfactory results. This mixture, properly applied, will prove effective in killing both adults and nymphs.

In a series of tests with poison baits near Melbourne, Fla., the only practicable method found for applying the poison solution on a large scale was to sprinkle it on the plants in the form of coarse droplets. If a soluble arsenical, such as sodium arsenate, is sprayed on cotton, too much of the foliage is covered, and serious damage results. Where it is sprinkled on, however, the area covered is small, and the plants are not injured seriously unless a large number of applications are made. In practice, the "slinging" method of application, described elsewhere, was satisfactory.

If it is necessary to poison the stainer in the early fruiting stage of the cotton, while the plants are comparatively small, slinging, as practiced on large cotton, is wasteful of material, as most of it will fall on the ground instead of on the plants. However, two rows of such cotton can be slung in such a manner that most of the material will fall on the plants. The technique followed for two row slinging is as follows:

While walking at a steady gait down the middle, the operator holds the pail containing the poison somewhat in front. The short-handled mop is dipped an inch or so into the mixture and quickly withdrawn, being dragged against the side of the pail to remove some of the excess poison, and held, handle and forearm vertical, above the cotton. Liquid will then be dripping from the mop. A gentle swing of the mop forward directs the drippings down the row eight or ten feet. If this swing is made correctly most of the poison will fall on the cotton, and leave the mop in an upraised position. Then a smart swing of the mop diagonally downward and to the left sprinkles the left row over a space of eight or ten feet, and places the mop low and to the left. It is quickly raised to a point about as high as, and directly in front of, the left shoulder, and then swung diagnoally downward and to the right, throwing the last of the poison on the right row. This leaves the mop in a convenient position for dipping and repeating the operation.

It would perhaps be best for the beginner to sling only the row on his right until the knack of quickly dipping the mop and throwing the poison in a given direction is mastered. After a little practice, the two row slinging operation can be carried out at an ordinary walk. In this manner an operator can easily poison two acres of cotton an hour. After the cotton is large and most of the liquid poison falls on the plants when slung at random, two or more rows on each side of the operator can be slung, but the operator will have to walk somewhat slowly. While the cotton is in the early blossoming stage a gallon and a half of poison solution will be enough to apply on an acre at each application. As the cotton grows larger, the amount should be gradually increased.

TIME TO BEGIN POISONING

Stainers appear neither to do much damage nor to multiply rapidly in cotton until bolls begin to appear. As soon as the cotton reaches the blossoming stage, however, close watch should be kept for stainers. When they appear in appreciable numbers, poison applications should be begun, if hand picking or spraying with pyrethrum solutions appear to be impracticable. Two row slinging at weekly intervals will prevent the stainers from multiplying unduly. If it is necessary to begin poisoning in the early blosoming stage, six or eight applications might be necessary to prevent them from becoming numerous before the bolls are mature. If it is not necessary to begin poisoning until a later stage of

development, fewer applications of poison will be needed. Much will depend upon the surrounding conditions. After the stainer-host-plant relationships are better understood, control will no doubt be simpler.

THE STAINER AND CITRUS

Instances have been reported in which the stainer migrated from cotton to citrus, and inflicted considerable damage to ripening fruit. These instances are rare, however, and we feel that they are due to some abnormal conditions which need not arise in the case of Sea Island cotton. The stainer appears to migrate from Sea Island cotton only under exceptional conditions, such as where excessive rotting of the bolls, or a general break down of the plant, occurs. If the stainer population is kept down, no migration of consequence will take place even under these conditions.

COST OF SODIUM ARSENATE

Drug stores carry only the pure grade of sodium arsenate, and usually charge about ten cents an ounce for this product. If any appreciable quantity is to be used, however, a commercial grade of sodium arsenate can be ordered.

CAUTION

Sodium arsenate, like all other arsenicals, is a deadly poison, and must be used accordingly. Only such quantity of mixture that is needed for immediate use should be made. Especial care should be exercised to prevent children from gaining access to the sweetened mixture. In case of arsenic poisoning, however, give lime water, raw eggs, emetics, and send for a physician.

GROWING SEA ISLAND COTTON IN NEW TERRITORY

As suggested previously, Sea Island cotton probably can be grown successfully in many areas where it has never been cultivated. The matter should be studied carefully, however, before large sums are invested in its culture in a new locality. Soil, climate, labor and marketing conditions must be favorable before it can become a profitable crop.

Little is known of the possibilities of Sea Island cotton even in Florida outside the original Sea Island Belt. In the Melbourne area, for instance, where a number of experimental plantings were made in 1938, it was found that on

acid muck and semi-muck soils, Sea Island cotton grew well, and put on a good crop of bolls, but most of them rotted. On the lighter, less acid soils, smaller plants were produced, which fruited well, and matured the bolls. Apparently, until more is known about how to grow Sea Island on muck soils as acid as pH 5.5, they should be avoided except for experimental plantings. However, the lighter soils, whose acidity runs pH 5.8 and up, appear to be safe for Sea Island.

In the Melbourne area, the cotton stainer appeared in unexpected numbers. Whether or not they will be as abundant in other years, of course, remains to be seen. In some sections, the stainer is abundant only occasionally. However, due to the abundance of known host plants in the Melbourne area such as Caesar weed, Turk's Cap, and Hibiscus, probably the stainer will be abundant at least during most seasons. Moreover, we think it probable that the stainer will become more numerous than at present in Alachua, Marion, Sumter, and surrounding counties if considerable acreage of Sea Island cotton is planted over a period of years.

The most satisfactory time of planting is not known for the Melbourne area. It appears that picking must be done in the summer or early fall, when laborers are not busy with vegetables or fruit, else labor for picking will be impossible to obtain or unduly expensive. This will require very early planting. But will moisture conditions make this feasible, except for irrigated lands? Bedding the land six or eight weeks before planting and then conserving the moisture as much as possible might solve this problem.

Then, what of the possibilities of planting in the fall as far south as Melbourne or Tampa? Sea Island cotton planted around October 1 in this part of the state would have plenty of moisture to get a good start, but no doubt would be killed back by frost during the winter. Possibly, however, it would sprout profusely in January or early February, and mature a crop early enough for it to be gathered before the usual summer rainy period sets in. However, no one can foresee what problems might be encountered if this plan were tried. No doubt the cotton would be heavily infested by the stainer, and only experience could answer the question as to whether a stainer poisoning program would have to be carried out in the fall or winter, or whether it would be just as well to wait until it sprouted and began to fruit in the spring.

What of the possibilities of making two crops a year as far south as Melbourne or Tampa? With very early spring planting, or possibly fall planting, this is a possibility worth considering. Again it must be emphasized that only time and experimentation will show its feasibility or non-feasibility. Such experiments, however, should be conducted on a small acreage basis, and on varying soil types. Unexpected difficulties, whose solution might be either easy or complex, are bound to arise.

Finally, what of the possibilities of Sea Island cotton still farther south than Melbourne?*

There are entirely too many unknown factors involved to attempt even a speculative answer to the above question, other than to call attention to the fact that the farther south in Florida you go, the more involved the labor situation becomes, so far as general farming is concerned. Very likely there are localities in Florida where it would cost as much to gather Sea Island cotton as could be gotten for it. Investors are advised, therefore, not to "plunge" on Sea Island cotton in any locality where it has not already been successfully grown.

CONCLUSION: A FEW "DON'TS"

Don't plant large acreages to Sea Island cotton until you have grown at least one crop under weevil conditions.

Don't plant more Sea Island acreage than your family can harvest. In the case of the average one-horse farmer this will approximate four to six acres.

Don't plant poorly drained lands or land that is totally unadapted to cotton culture and then expect the poison program to make your crop. It can't do the impossible. Plant Sea Island well away from woods or swamps and other good weevil hibernation quarters.

Don't plant inferior seed or seed known to be contaminated with upland cotton. Get certified seed.

*We think, for the present at least, the presence of the Pink boll worm-infested wild cotton on the keys make it advisable not to attempt to plant cotton south of a line extending west from Melbourne through Hillsborough County. The Pink boll worm is difficult to eradicate and, should cotton be planted below the line suggested, there is no doubt but that it would soon become infested by this pest.

Don't use excessively heavy applications of fertilizer. Fertilizers with excessive nitrogen content will produce too much stalk growth. About 300 to 400 pounds of a well balanced fertilizer per acre plus a side dressing of nitrate of soda of about 75 pounds per acre will pay handsomely. A mixture of phosphoric acid, cottonseed meal and kainit will give profitable results. If excessive leaching of fertilizer from heavy rainfall occurs during the early growing season side applications of at least 100 pounds of a 9-0-12 or 9-0-15 mixture will give good results.

Don't plant Sea Island cotton late. In weevil infested areas the crop must be planted during the first half of March. If it becomes necessary to replant and this operation cannot be done until April, plant the land to some other crop. Remember the crop must be matured by the date of the annual weevil migration—about July 15th. Success in growing Sea Island cotton in Florida depends mainly on early planting and the successful poisoning of the over-wintered weevils.

Don't plant Sea Island cotton without some fertilizer under it as it is most important to get the plants up and growing as quickly as possible in order to produce a profitable crop before the annual summer migration of the weevil.

Don't cover the seed more than one inch at planting time. It is better to have the seed half covered than covered too deep.

Don't let the young cotton go backward or turn yellow and get off-color. When young plantlets show off-color or a general slow down in growth stimulate with about 50 pounds of nitrate of soda per acre.

Don't fail to leave ample plants on the ground at thinning or chopping time. Two plants at about 16 to 18 inch intervals on thin soils and 22 to 24 inch intervals on heavy soils in four foot rows appears to be about the proper spacing.

Don't fail to have on hand ample supplies of Calcium Arsenate and molasses well in advance of the date of the first poison application.

Don't fail to begin the weekly poisoning or mopping when the plants reach the "pre-square" stage. The "pre-square" stage is reached when plants have about 10 leaves or the week before the first squares appear.

Don't wait until after weevils have punctured squares to start the weekly poison program. If the poison kills all the over-wintered weevils the egg-infested squares will soon hatch out another supply of adults.

Don't delay any of the weekly poison applications on the theory that all weevils have been killed. Keep poisoning until June 12-14 in fields where no moss-covered timber occurs and until 18-20 in fields where moss-covered timber is nearby.

Don't permit last year's stubble plants to put up sprouts or fruiting branches as an early weevil generation will mature and migrate to the cultivated poison fields about June 15.

Don't expect profitable crops of Sea Island cotton where the poisoning operation is only half done. It has been proven that all over-wintered weevils will be eradicated if the poison operation is started on time and properly carried out.

Don't permit a single weevil to be in your field at the end of the poisoning season. If, for any unknown reason, an infested spot is found in the field, flag the location, go back to it at least two to three times each week and gather all infested squares. At the time the spot is located poison a circle about 100 feet in all directions from the infested spot in order to kill the female weevil.

Don't fail to take advantage of weather conditions during the poisoning season. If your poison date falls on Wednesday and indications point to rain on that day poison on Tuesday or at a six day interval. It is much better to be a day ahead with the poison schedule than a day late.

Don't miss an application during the poisoning season and expect good weevil control. Allowing the cotton to go two weeks between poison applications will nearly always defeat the poison program.

Don't expect to control migratory weevils under Florida weather conditions. The rainy season usually begins about July 1 and lasts for four to six weeks. The annual summer weevil migration usually starts from unpoisoned cotton fields about July 15. Under such long, almost daily rain seasons, neither dusting, spraying or mopping will pay in the hands of an average farmer.

Don't dust young cotton plants. Buy both poison and molasses and use the poisoned-syrup mixture.

Don't leave poison, mops and buckets where children or livestock can get to them.

Don't fail to start harvesting when the plants show three to five open bolls per plant as open Sea Island cotton deteriorates rapidly under field conditions.

Don't fail to dry harvested cotton in the sun for at least four weeks before ginning. Drying and hand-picking trash before ginning will insure better prices.

Don't sell cotton in the seed. Have it ginned as it will pay you handsomely.

Don't plant Sea Island cotton in the southern edge of the Florida Belt without making provisions to poison the cotton stainer.

Don't plant Sea Island cotton south of a line extending from the Melbourne area on the east to Hillsborough County on the west due to the possibility of infestation by the Pink boll worm which infests the wild cottons on the Florida keys.

Library
N. C. State College